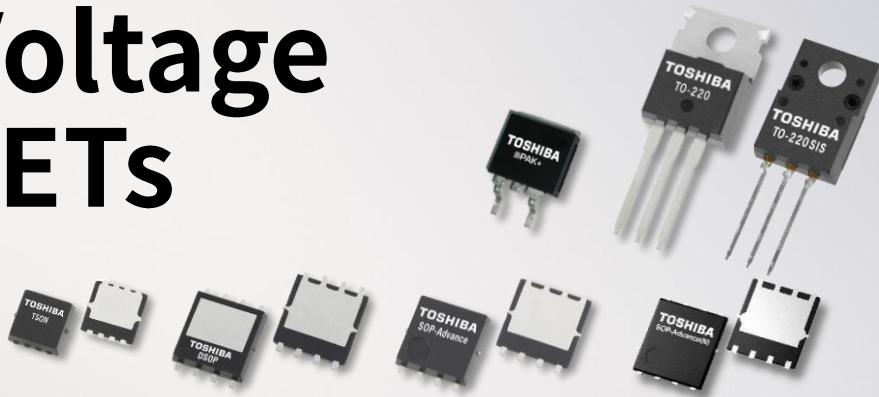


# Low Voltage MOSFETs



## Latest MOSFET Technology

U-MOS IX-H and X-H are high-efficiency Low Voltage (LV) MOSFET series, specifically designed for use in the secondary side of AC/DC power supplies for power adapters and servers as well as DC/DC power supplies for communication equipment such as servers and data center. The mentioned U-MOS –series are also suitable for motor drives, UPS and machine tools. U-MOS X-H and selected U-MOS IX-H are adopting a new cell structure that reduce the voltage spikes and ringing during switching which contributes for greater higher efficiency. Moreover the new SOP Advance (N) package in 5 x 6 mm dimension for improved compatibility is introduced .

## Applications

- Power supplies
- Industry automation
- Servers
- Power adapters
- UPS
- Power tools
- Battery packs

### Features

- Latest U-MOS IX-H / X-H trench process, complementing U-MOS-VIII line-up to cover  $V_{DSS}$  (30V-250V) and  $R_{DS(ON)}$  values down to 0.6m $\Omega$
- Top-level performance in on-resistance per die area ( $R_{ON} \cdot A$ )
- Improving trade off between  $R_{DS(ON)}$  and  $Q_g/Q_{SW}/Q_{OSS}$
- $T_{ch,max}$ : 175°C since U-MOS IX-H
- Package option: double side cooling
- Low spike solutions since U-MOS IX-H

### Advantages

- Wide product line-up is applicable in various power applications
- Significantly better trade-offs between on-resistance ( $R_{DS(ON)}$ ) and charge characteristics allow high efficiency switching
- More thermal safety head room
- Ideal for applications that require power density, smaller size etc.
- Less EMI effects at low spike type

### Benefits

- Attractive cost effects
  - Lower system costs due to fast switching & smaller form factor
  - Low service costs based on increased lifetime (cooler system) to reduce costs of operation failures
  - Flexible system costs by cost variations related to product construction (topology)
- Smart performance increases
  - Improved end product quality
  - Improved competitiveness

### U-MOS - series

U-MOS X-H: low spike,  $T_{ch,max}$ : 175°C, narrow  $V_{th}$  distribution, **NEW** Improved  $R_{DS(ON)} \times Q_g$ ,  $R_{DS(ON)} \times Q_{SW}$ ,  $R_{DS(ON)} \times Q_{OSS}$

U-MOS IX-H:  $T_{ch,max}$ : 175°C, low  $Q_{OSS}$  & low  $Q_{SW}$

U-MOS VIII-H: up to high voltages 250V

### Application examples

For server, DC/DC converter, synchronous rectifier

For server, DC/DC converter, motor drives, power supply

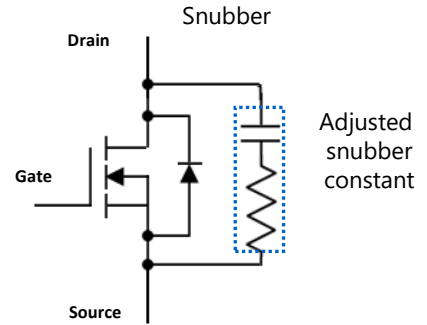
For general switching

# U-MOS highlights

Aiming to simplify design engineer's job whilst offering maximized MOSFET performance, Toshiba developed various solutions.

## Low spike technology

Toshiba is enabling switching noise reduction by adopting improved snubber functionality for selected 40V & 60V U-MOS IX-H and all U-MOS X-H series. With this new technology, Toshiba can offer low voltage spike and ringing for both resistive and inductive loads.



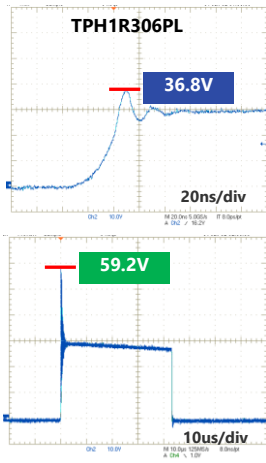
TPH1R306PL high speed switch type

Example:

60V, 1.3mΩ

SOP Advance (5x6mm)

TPH1R306P1 low spike type

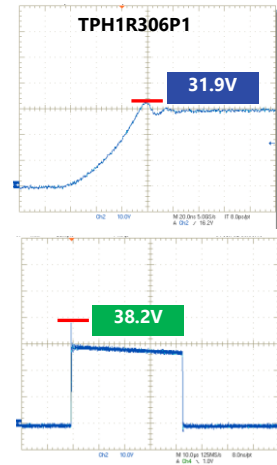


R-load switching waveform

$V_{DD}=30V$ ,  $I_D=50A$   
 $R_G=4.7\Omega$ ,  $R_{GS}=4.7\Omega$   
 Resistance load  
 $T_a=25^\circ C$

L-load switching waveform ( $t_{rr}$ )

$V_{DD}=30V$   
 $I_{DR}=25A$   
 $di/dt=220A/\mu s$   
 $T_a=25^\circ C$



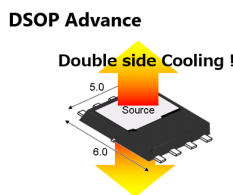
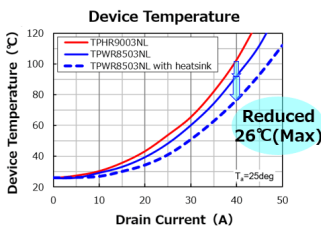
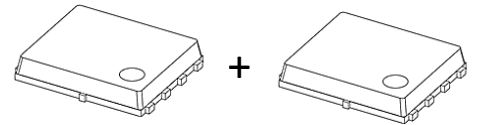
## Improved $V_{th}$ distribution for simplified paralleling of MOSFETs

Since U-MOS X-H the distribution of threshold voltage is narrowed.

UMOS VIII-H example: TPH4R008NH  $V_{gs(th)}$  between 2.0V~4.0V → 2V window.

UMOS X-H example: TPH4R008QM  $V_{gs(th)}$  between 2.5V~3.5V → 1V window.

Advantage: Simplified paralleling in power applications is possible.



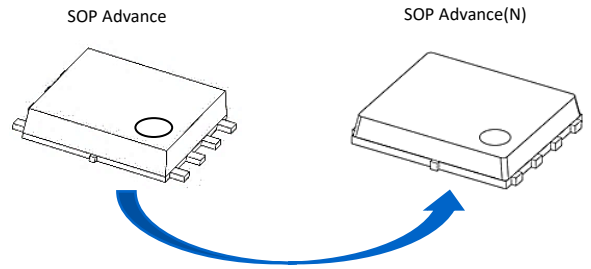
## Dual side cooling

The DSOP double-side cooling package can use the same footprint as the 5x6mm SOP-Advanced. Due to the strongly reduced thermal resistance, the maximum load can be increased considerably. Alternatively the MOSFET temperature can be reduced to increase long term reliability.

Same chip inside

## New SOP Advance (N) package

Toshiba is offering beside SOP Advance an additional package option for the surface mounted 5x6mm: SOP Advance(N), targeting to improve foot print compatibility. Where available, the datasheet will indicate both options.



## U-MOS VIII-H, U-MOS IX-H & U-MOS X-H – Product line-up 30V ~ 60V

$V_{DSS}$ (V)	$R_{DS(ON)}$ in $m\Omega$	TO-220SIS	TO-220	SOP Advance 5x6mm	SOP Advance (N) 5x6mm	DSOP Advance 5x6mm	TSON Advance 3x3mm	DPAK
30	10-20			TPH11003NL			TPN11003NL	
	5-10			TPH8R903NL TPH6R003NL			TPN8R903NL TPN6R003NL TPN5R203PL*	
	3-5			TPH4R803PL* TPH4R003NL TPH3R203NL			TPN4R303NL	
	1-3			TPH3R003PL* TPH2R903PL* TPH2R003PL*	TPH1R403NL1		TPN2R703NL TPN2R903PL* TPN1R603PL*	
	<1				TPHR9003NL1 TPHR9203PL1* TPHR6503PL1*	TPWR8503NL TPWR6003PL*		
40	5-10			TPH7R204PL* TPH6R004PL*			TPN7R504PL*	
	3-5	TK3R1A04PL*	TK3R1E04PL*	TPH3R704PL*			TPN3R704PL*	TK3R1P04PL*
	1-3			TPH2R104PL* <b>NEW</b> TPH1R204PB**	TPH1R204PL* TPH1R204PL1*		TPN2R304PL*	
	<1			<b>NEW</b> TPHR7404PU**	TPHR8504PL1*	TPWR8004PL*		
45	1-3			TPH1R405PL* TPH1R005PL*	TPW1R005PL*		TPN2R805PL*	
60	20-30						TPN22006NH	
	10-20	TK30A06N1 TK40A06N1	TK30E06N1 TK40E06N1	TPH14006NH TPH11006NL			TPN14006NH TPN11006PL*	
	5-10	TK58A06N1 TK8R2A06PL* TK5R3A06PL*	TK58E06N1 TK8R2E06PL* TK5R1E06PL*	TPH9R506PL* TPH7R506NH TPH7R006PL* TPH5R906NH			TPN7R506NH TPN7R006PL*	TK6R7P06PL*
	3-5	TK4R3A06PL* TK3R3A06PL*	TK4R3E06PL* TK3R2E06PL*	TPH4R606NH TPH3R506PL*			TPN4R806PL*	TK4R4P06PL*
	1-3	TK100A06N1	TK100E06N1	TPH1R306P1**	TPH1R306PL1* TPH2R506PL* TPH2R306PL1* TPH2R306NH1	TPW1R306PL*		

\* U-MOS IX-H technology; \*\* U-MOS IX-H low spike technology; \*\*\* U-MOS X-H technology

# U-MOS VIII-H, U-MOS IX-H & U-MOS X-H – Product line-up 75V ~ 150V

$V_{DSS}$ (V)	$R_{DS(ON)}$ in mΩ	TO-220SIS	TO-220	SOP Advance 5x6mm	SOP Advance(N) 5x6mm	DSOP Advance 5x6mm	TSON Advance 3x3mm	DPAK
75	1-3			TPH2R608NH		TPW2R508NH		
80	20-50						TPN30008NH	
	10-20	TK35A08N1	TK35E08N1	TPH12008NH			TPN19008QM*** TPN12008QM***	
	5-10	TK46E08N1 TK72A08N1 TK6R8A08QM*** TK5R1A08QM***	TK46E08N1 TK72E08N1 TK7R0E08QM*** TK5R3E08QM***	TPH8R008NH <b>NEW</b>	TPH8R008QM*** <b>NEW</b>		TPN8R408QM***	TK6R9P08QM*** TK5R1P08QM***
	2-5	TK3R2A08QM*** TK100A08N1 TK2R4A08QM***	TK3R3E08QM*** TK100E08N1 TK2R4E08QM***	TPH2R408QM*** <b>NEW</b>	TPH4R008NH1 TPH4R008QM*** <b>NEW</b> TPH3R008QM*** TPH2R408QM***	TPW4R008NH		
100	20-50						TPN3300ANH	
	10-20	TK22A10N1 TK110A10PL*	TK22E10N1* TK110E10PL*	TPH1400ANH			TPN1600ANH TPN1200APL*	TK110P10PL*
	5-10	TK34A10N1 TK40A10N1 TK7R4A10PL* TK6R7A10PL*	TK34E10N1 TK40E10N1 TK7R2E10PL* TK6R4E10PL*	TPH8R80ANH TPH6R30ANL TPH5R60APL*				TK7R7P10PL*
	3-5	TK65A10N1 TK4R1A10PL* TK100A10N1 TK3R2A10PL*	TK65E10N1 TK3R9E10PL* TK100E10N1	TPH4R10ANL <b>NEW</b>	TPH4R50ANH1 TPH3R70APL1* <b>NEW</b> TPH3R10AQM***	TPW4R50ANH TPW3R70APL*		
	<3		TK2R9E10PL*					
120	10-20	TK32A12N1	TK32E12N1					
	5-10	TK42A12N1 TK56A12N1	TK42E12N1 TK56E12N1					
	3-5	TK72A12N1	TK72E12N1					
150	50-100			TPH5900CNH			TPN5900CNH	
	20-50			TPH3300CNH			<b>NEW</b> TPN4800CQH***	
	5-20				<b>NEW</b> TPH1500CNH1 <b>NEW</b> TPH1400CQH*** <b>NEW</b> TPH9R00CQH*** <b>NEW</b> TPH9R00CQ5****	TPW1500CNH		
200	100-200			TPH1110ENH			TPN1110ENH	
	50-100			TPH6400ENH				
	20-50			TPH2900ENH		TPW2900ENH		
250	200-300			TPH2010FNH			TPN2010FNH	
	100-200			TPH1110FNH				
	50-100			TPH5200FNH		TPW5200FNH		

\* U-MOS IX-H technology; \*\* U-MOS IX-H low spike technology; \*\*\*U-MOS X-H technology \*\*\*\* U-MOS X-H with high speed diode